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Brief Report

Are pro-social or socially aversive people more physically symmetrical? Symmetry in relation to over 200 personality variables

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A B S T R A C T

Symmetry on bilateral body parts indicates evolutionary fitness. Thus, traits positively associated with symmetry are thought to have conferred fitness in evolutionary history. Studies of the relationships between personality traits and symmetry have been narrow and have produced inconsistent findings. In our study, we relate both body symmetry and facial symmetry to 203 personality variables and to the Big Five. Our results demonstrate that (a) symmetry is related to personality traits beyond chance, (b) socially aversive traits, such as aggression and Neuroticism are positively related to symmetry, and (c) pro-social traits such as empathy and Agreeableness are negatively related to symmetry. Such trait levels may developmentally adjust in response to symmetry or may be inherited with symmetry (i.e., dual inheritance).

1. Introduction

Bilateral symmetry is a moderately heritable trait (Blanckenhorn, Reusch, & Muhlhauser, 1998; Johnson, Gangestad, Segal, & Bouchard, 2008) that is a traditional indicator of evolutionary fitness (Thornhill & Gangestad, 1996; Van Valen, 1962). Symmetry is thought to reveal overall evolutionary fitness because it is a general indicator of robust physical build. Given the implications of bilateral symmetry for fitness, understanding the relationship between symmetry and personality has the potential to elucidate the evolutionary significance of personality traits. Thus, it is unsurprising that associations between personality and symmetry have played a prominent role in the emerging literature concerning the evolutionary origins of personality (e.g., Eastwick, 2009; Penke, Denissen, & Miller, 2007).

In the current research, we attempt to clarify the link between personality and physical symmetry by addressing two major issues. First, we aim to determine whether personality is related to symmetry overall. One major theory in evolutionary personality psychology maintains that personality is unrelated to general evolutionary fitness (Penke et al., 2007), and some empirical evidence suggests that this may be the case (Hope et al., 2011). This theory implies that personality traits are selectively neutral on the whole and that, unlike intelligence for example, personality traits are not universally adaptive (Bates, 2007; Furlow, Armijo-Prewitt, Gangestad, & Thornhill, 1997). In other words, certain levels of a given personality trait may be more or less beneficial at different times and in different environments, with each level of a trait filling its own ecological niche. According to this view, personality traits were not fitness-enhancing for sustained periods of evolutionary time and thus symmetry should not correlate with personality. Given the important implications of these conclusions for inferring the adaptive value of personality traits, in the current research we explore this topic further, as we attempt to provide a comprehensive study of the relationship between personality traits and symmetry.

A second aim of our study is to identify the specific personality traits that are most associated with symmetry. Some studies have shown that symmetry is significantly related to extraversion (Fink, Neave, Manning, & Grammer, 2005; Pound, Penton-Voak, & Brown, 2007), openness (Fink et al., 2005), intrasexual competitiveness (Simpson, Gangestad, Christensen, & Leck, 1999), antisociality (Lalumiere, Harris, & Rice, 2001), dominance (Grammer & Thornhill, 1994) and lower levels of distress (Shackelford & Larsen, 1997). Collectively, these results point to a small positive association between symmetry and dominance-related traits that involve social liabilities. However, inconsistency in this pattern of effects has led several researchers to conclude that personality and symmetry are unrelated (Hope et al., 2011).

Perhaps the biggest impediment to developing a coherent account of these associations is that the methods have varied across

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studies. Bilateral symmetry can be measured on the face or body, but few studies have examined the two measures simultaneously. Moreover, these studies have typically only examined very broad personality traits without exploring the many facets of these traits. Here, we attend to both of these important issues by presenting a study in which we relate both body and facial symmetry to 203 personality variables. To situate our results into the wider personality literature, we also relate symmetry to the Big Five personality factors.

2. Method

2.1. Participants

A total of 175 undergraduates (56% female; age $M = 19.4$, $SD = 1.22$; 66% Caucasian, 20% Asian, 9% black, and 5% other) from a private, Midwestern university participated in exchange for partial course credit.

2.2. Self-reports of personality

The Analog for Multiple Broadband Inventories (AMBI; Yarkoni, 2010), a 181-item personality inventory, was used to assess 203 personality variables from eight of the most prominent inventories of personality. The initial 2019 items comprising these inventories was reduced to just 181 essential items by using an algorithm which allows any given item to load onto multiple scales. The algorithm minimizes scale length (the 203 variables are assessed with 5 items each) and maximizes predictive validity, although it does sacrifice internal consistency to a small degree. Considering the brevity of the AMBI facets, the average of the reliability coefficients was reasonable ($\alpha = .64$).

Moreover, to explore general personality factors, we derived Big Five scores from the AMBI by using all AMBI items designed to assess each Big Five factor. Openness to Experience (32 items), Conscientiousness (24 items), and Agreeableness (32 items) were assessed using the relevant AMBI items corresponding to the NEO (Costa & McCrae, 1992) and HEXACO inventories (Lee & Ashton, 2004); Extraversion (34 items) was assessed using the relevant AMBI items corresponding to the NEO, HEXACO, and Jackson Personality Inventories (Jackson, 1994); and Neuroticism (20 items) was assessed using the relevant AMBI items corresponding to the NEO inventory. Any items that were used for two or more scales were entered only once into the computation of coefficient alpha, thus controlling for inflation of the reliability coefficient; the reliability coefficients for each of these scales were good ($\alpha \geqslant .80$).

2.3. Body symmetry

Participants were measured using digital calipers that were precise within 0.01 mm. Points of measurement were the ankle, elbow, wrist, index finger, pinky finger, height of the ear, length of the ear, and ball of the foot, each of which were measured twice on the left and right sides of the body. Same-side measurements (e.g., both left-side measurements of the ear) that differed by more than 3 mm and measures of body parts that had been injured were excluded. Percent asymmetry for each measurement point was calculated as $[|(M_{\text{Left}} - M_{\text{Right}})|/M_{\text{Both}}] \times 100$ (as in Bates, 2007).

2.4. Facial symmetry

Photographs of participants were used for facial symmetry calculations. Using the TPS software suite (http://life.bio.sunysb.edu/morph), photographs were marked with 39 easily identifiable landmarks that are known indicators of facial symmetry (see: Sanchez-Pages & Turiegano, 2010). The Procrustes distance between each landmark and the corresponding landmark in a mirror-image of the photo was then calculated using the program Morpho J (http://www.flywings.org.uk/MorphoJ_page.htm). Procrustes distances were summed, resulting in a total asymmetry score (which is highly correlated with fluctuating asymmetry: $r = .98$, Sanchez-Pages & Turiegano, 2010).

2.5. Composite symmetry

Facial and body asymmetry scores were reversed, standardized, and averaged to create a composite symmetry score. Even though the two measures of symmetry were virtually unrelated ($r = .11$, $p = .15$), we reasoned that both types of symmetry represent (relatively statistically independent) indicators of fitness-relevant features. Thus, the two measures were combined into a composite symmetry measure. Nevertheless, we also present the results separately for facial and body symmetry.

3. Results

3.1. Statistical correction for exploring many effects

To rule-out the possibility that the overall pattern of results was due to chance, we employed Sherman and Funder's (2009) randomization routine, which allows simulation of the number of significant effects expected in random data while perfectly preserving the correlations among the relevant variables (here, the 203 personality facets). Results indicate that 10.23 significant effects ($SE = 10.77$) would be expected if the data were random; we obtained 47 significant effects, $p = .02$. Thus, the overall pattern of results is informative and not a result of capitalizing on chance—personality, in general, is related to symmetry.

3.2. Correlations between personality and composite symmetry

Tables 1 and 2 display correlations between personality and symmetry. A table including the results for all 203 facets of the AMBI, as well as analyses based on sex and symmetry type (i.e., facial or body), is provided in Supplemental online material. At first glance, our results seemed to indicate that socially aversive traits were positively associated with composite symmetry, while prosocial traits were negatively associated with composite symmetry, and we noticed this pattern at both the facet level and at the level of the Big Five Factors of neuroticism and agreeableness (in the zero-order correlations).

3.3. Moderators

To clarify the nature of the personality–symmetry relationship, we examined three potential moderators: the socially aversive nature of the personality traits, the type of symmetry examined, and participant sex.

We conducted a formal test to determine if the socially aversive nature of each of these personality facets explained the observed links between symmetry and personality. Three undergraduate research assistants rated the socially aversive qualities of each of the 203 AMBI facet scales (-5 = pro-social; 0 = neutral; +5 = socially aversive); these ratings are available in Supplemental material online (see Excel sheet 2). Agreement between raters was good (ICC[2,1] = .67; ICC[2,k] = .86). The averages of these ratings were then correlated with the personality–symmetry relationships found in our prior analyses (after subjecting those effects to Fischer's r-to-z transformation). Consistent with our interpretation that social aversiveness helped to explain our pattern of effects, the

Table 1
Largest positive and negative correlations between the three symmetry scores and the 203 personality variables measured.

Rank	Body Symmetry	*r*	Facial symmetry	*r*	Composite symmetry	*r*
1.	Disorderliness	.16	Impression management	.24	Disorderliness	.25
2.	Aggression	.14	Stress Reaction	.22	Aggression	.23
3.	Angry Hostility	.10	Alienation	.22	Angry Hostility	.20
4.	Self-forgetful	.10	Aggression	.22	Risk Taking	.19
5.	Excitement-Seeking	.09	Angry Hostility	.21	Impression management	.19
6.	Risk Taking	.08	Self-Consciousness	.20	Self-forgetful	.19
7.	Self focus	.08	Anxiety	.20	Stress Reaction	.18
8.	Order	.07	Worry and pessimism	.19	Anxiety	.17
9.	Math ability	.07	Anxiety	.19	Excitement-Seeking	.17
10.	Organization	.06	Depression	.19	Thrill-seeking	.16
⋮						
194.	Good-natured	−.14	Good attachment	−.21	Not spontaneous	−.20
195.	Fairness	−.14	Even-tempered	−.21	Empathy	−.20
196.	Responsibility	−.14	Tough-mindedness	−.21	Even-tempered	−.20
197.	Forgiveness	−.14	Empathy	−.21	Norm-Favoring	−.20
198.	No hostility	−.14	Calmness	−.22	Fairness	−.20
199.	Gentleness	−.14	Amicability	−.22	Responsibility	−.20
200.	Flexibility	−.15	Trust	−.22	Even-tempered	−.22
201.	Compassion	−.16	Responsibility	−.23	Impulse control	−.22
202.	Abasement	−.18	Even-tempered	−.23	Patience	−.25
203.	Patience	−.18	Socialization	−.26	Socialization	−.26

Where $|r| \geqslant .15$, $p < .05$; where $|r| \geqslant .20$, $p < .01$.

Table 2
Zero-order correlations (and beta-weights) relating Big 5 personality traits to symmetry.

	Type of physical symmetry		
	Body	Face	Composite
Openness to Experience	.05 (-.01)	−.02 (.02)	−.01 (.03)
Conscientiousness	.02 (.03)	−.11 (−.07)	−.10 (−.07)
Extraversion	.02 (−.01)	−.07 (−.02)	−.02 (.02)
Agreeableness	.14** (−.14)	−.16* (−.12)	−.19* (−.16**)
Neuroticism	.04 (−.01)	.20* (.14)	.16* (.11)

Zero-order intercorrelations among the Big 5 ranged from −.38 for agreeableness and neuroticism to +.33 for openness and extraversion. To compute the beta-weights, all five personality traits were entered into a multiple regression.
* $p < .05$.
** $p < .10$.

averages of the ratings of socially aversive qualities predicted the personality–symmetry relationships for body symmetry ($r = .47$), facial symmetry ($r = .60$), and composite symmetry ($r = .57$); more socially aversive traits showed stronger, positive relationships with symmetry.

The second potential moderator we explored was symmetry type. The average effect sizes for facial symmetry were larger in absolute value than those for body symmetry ($|r| = .09$ vs .05). Sherman and Funder's randomization test revealed that facial symmetry yielded a reliable pattern of effects overall (44 significant vs. 10.11 expected; $p = .02$, $SE = 10.47$), whereas body symmetry did not (4 significant vs. 10.37 expected; $p = .72$, $SE = 9.9$). To further explore the effect of symmetry type, we ran a column-vector analysis, which involves correlating the personality–symmetry effects for body symmetry with those found for facial symmetry. Large, positive correlations resulting from a column-vector analysis indicate a similar pattern of effects for the two variables. Our results showed that the patterns of effects (*r*-to-*z* transformed) for body and facial symmetry were highly positively correlated ($r = .52$, $p < .01$), indicating a similar pattern of effects. In sum, despite the non-significant pattern of results for body symmetry revealed by Sherman and Funder's randomization test, the pattern of effects for body symmetry was similar to the pattern of effects for facial symmetry.

Finally, we explored participant sex as a potential moderator. The mean $|r|$s for men (.11) and women (.10) were comparable, suggesting that the overall effect is not attributable to just one sex. Moreover, a column-vector analysis for the composite measure of symmetry (*r*-to-*z* transformed) indicates that the pattern of effects is somewhat similar ($r = .35$, $p < .001$) between genders, with men and women showing modest similarity in their overall patterns of personality–symmetry effects. For body symmetry, the patterns of effects (*r*-to-*z* transformed) were negligibly correlated between genders ($r = -.08$, $p = .26$), whereas for facial symmetry the patterns were highly correlated between genders ($r = .48$, $p < .001$). Thus, the similarity in personality–facial symmetry effects seems to be driving the similarity observed in personality–composite symmetry effects. Last, we explored whether the within-gender patterns of effects were correlated with the research assistants' ratings of social aversiveness for the AMBI facets. Indeed, the *r*-to-*z* transformed effects for body symmetry (male $r = .41$, female $r = .23$), facial symmetry (male $r = .47$, female $r = .53$), and composite symmetry (male $r = .52$, female $r = .42$) were associated with the social aversiveness of the AMBI traits for both men and women.

4. Discussion

In this study, we examined the relationship between personality and symmetry using an extensive battery of personality measures and a rigorous method for measuring symmetry. Overall, our results demonstrate that symmetry is significantly related to personality—a conclusion at odds with theories that predict no association (Hope et al., 2011; Penke et al., 2007), and in concert with theories that do predict an association (Simpson et al., 1999). Thus, it appears that personality is related to one key indicator of evolutionary fitness. More specifically, the effects between personality and symmetry could be characterized quite well by the social aversiveness of the personality traits: People higher in traits such as aggression, disorderliness, risk-taking, and anxiety are more physically symmetrical. These results may point to a physical signature of socially aversive traits.

The increased symmetry associated with socially aversive personality traits could be explained by two different, though not mutually exclusive, explanations: reactive heritability or shared

heritability processes. Regarding reactive heritability, people have the capacity to reflect on who they are—including their physical features—and to make inferences about their relative standing in the population (Lukaszewski & Roney, 2011; Tooby & Cosmides, 1990). That people can think (consciously or unconsciously) about their own physical stature could have a remarkable influence on personality development. If a person is extremely symmetrical and this influences his or her popularity (e.g., due to potential value as a romantic partner), then it is plausible that this person would become more exhibitionistic, for example. That is, physical prowess could ultimately shape people's personalities by providing them leeway to behave in socially aversive ways. In contrast, asymmetrical individuals may realize (across development) that exhibiting socially aversive traits would present an additional cost in their pursuit of friends or relationship partners. Thus, asymmetrical people may utilize pro-social behaviors to offset the social costs they have experienced due to being asymmetrical. According to this explanation, personality–symmetry relationships would emerge only indirectly, through personality development, and due to reflexive cognition about one's own morphological traits.

A second possible explanation is that symmetry and socially aversive traits are dually inherited; this is the shared heritability explanation. This explanation relies partially on the notion that symmetry is an indicator of fitness that is moderately heritable (Johnson et al., 2008). The correlation between socially aversive traits and symmetry (a known fitness indicator) suggests that socially aversive traits conferred fitness across many generations. Next, we attempt to identify an event in history that would have allowed for the emergence of the correlation between symmetry and socially aversive traits across generations of inheritance.

Because the symmetry literature is closely tied to the mating literature (Thornhill & Gangestad, 1994), it makes sense to discuss the correspondence between our data and theories about the history of human mating. The evolution of human mating hit a major switchpoint about two million years ago (Eastwick, 2009), when human attachment systems began to emerge and became a standard part of human psychology (see also Fraley, Brumbaugh, & Marks, 2005), ultimately influencing human mating systems. Many factors led to this shift (Lovejoy, 2009), but one crucial consequence was that humans maintained longer courtships; that is, humans shifted from a primarily short-term mating species (e.g., promiscuous relations) to a more long-term mating species (e.g., monogamy; see Eastwick (2009) and Lovejoy (2009) for more information on this emerging view). Given that the prevalence of short-term mating is non-zero today, it can be inferred that short-term mating did not go extinct; instead, it retained at least a small section of the mating market, thus creating a niche to be filled.

Two findings regarding short-term mating can shed light on how symmetry and socially aversive traits might be dually inherited today. First, short-term mating is linked to symmetry, such that people who are more symmetrical tend to have more mates (Thornhill & Gangestad, 1994). Thus, selection for symmetry in short-term mating contexts could maintain the correlation between short-term mating propensities and symmetry. Second, short-term mating is linked to socially aversive traits, with socially aversive individuals preferring and engaging in more short-term mating (Foster, Shrira, & Campbell, 2006; Harris, Rice, Hilton, Lalumiere, & Quinsey, 2007; Holtzman & Strube, 2011; Jonason, Li, Webster, & Schmitt, 2009). For example, one argument is that socially aversive traits (narcissistic traits in particular) were selected conditionally, based on the viability of short-term mating in the local environment, as described in a recent chapter by Holtzman and Strube (2011).

Taken together, if sexual selection in short-term mating contexts has continually selected for symmetry, and short-term mating aptitude has been bolstered by socially aversive traits, then it follows that short-term mating contexts could have dually selected for symmetry and socially aversive traits. This dual selection pressure would result in the links between socially aversive qualities and symmetry that we observed in the current research. Human short-term mating contexts may provide a persistent selection pressure for both socially aversive qualities and symmetry, which contributes to and maintains the correlations between these variables.

Regardless of whether the relationship between personality and symmetry is due to environmental pressures on heritable physical traits (reactive heritability) or the shared evolution of symmetry and personality traits (shared heritability), our results indicate that personality is indeed related to physical symmetry. Moreover, the social aversiveness of personality traits provides a useful way to characterize this relationship.

4.1. Future directions

The findings of our study provide a more comprehensive account of the relationship between personality and symmetry. However, our findings for specific personality traits do diverge from some previous studies on personality and symmetry. The first discrepancy is that we found that neuroticism-related traits are positively associated with symmetry, yet one study showed that some neuroticism-related traits (e.g., trouble staying asleep, jealousy) are negatively associated with symmetry (Shackelford & Larsen, 1997). A second discrepancy between our findings and the larger literature is that we did not find a positive association between symmetry and extraversion, but others have found evidence for this link (Fink et al., 2005). These discrepancies will have to be sorted-out in future meta-analyses as studies accumulate however, because although a number of studies have explored symmetry (Van Dongen & Gangestad, in press), relatively few have included associations between symmetry and personality.

One limitation of our study is the use of a college-age sample. Specifically, age may moderate the links between personality and symmetry. Moreover, relative to asymmetrical emerging adults, symmetrical emerging adults may be more likely to engage in socially aversive behaviors (which may be relatively unique to that developmental period). This potential moderator could be explored in future research.

Another possible direction for future research is to explore these effects in non-human primates, especially given that personality measures for primates are now available. If the relationship between personality and symmetry is due to dual inheritance, then primate species that have trade-offs in mating strategies (i.e., between short-term and long-term strategies) should yield comparable correlations between symmetry and aversive personality traits. However, species that use a menu of mating strategies differing from that of humans should yield very different correlations. For example, if long-term mating is the only major adaptive strategy in a primate species (e.g., gibbons), then it would make sense for symmetry to become associated with the traits that confer long-term mating success (probably pro-social traits). Future research is needed to examine these possibilities.

4.2. Summary

In sum, theoretical accounts of the relationship between symmetry and personality have already played a key role in shaping the debates on how human personality traits have evolved. Here, in one of the more comprehensive studies to date on personality and symmetry, we demonstrated that personality is related to symmetry in general. In addition, we found that it is socially aversive traits that are most positively associated with symmetry. These findings suggest two possible (although not mutually exclusive) explanations for the links between personality and symmetry: Socially aversive traits are influenced by physical fea-

tures, or socially aversive traits may have conferred a fitness advantage at some point during human evolution.

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Appendix A. Supplementary material

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.jrp.2011.08.003.

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